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Computatrum Personae: Toward a Role-Based Taxonomy of (Computationally Assisted) Performance

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Abstract

Computationally assisted performance is a burgeoning area for AI applications, and an important stepping stone toward the dream of generative and personalized narrative experiences. As more pieces of computationally assisted performance are developed, it will become ever more important to develop a vocabulary with which to describe them. Inspired by previous work in creating taxonomies for other related domains, this paper outlines a taxonomy for performance-based experiences, drawn from digital games, traditional theatre, and the hybrid of the two. Having such a taxonomy not only creates a common language with which to discuss such experiences, but reveals unexplored design space in the field, and the particular applications of artificial intelligence necessary to realize them.

Introduction

Computationally assisted performance is a burgeoning area for artificial intelligence applications, and an important stepping stone toward the dream of deeply interactive, generative, and personalized narrative experiences (Mateas and Wardrip-Fruin 2016). There are many dramatic experiences being created across many disciplines, including games, traditional theatre, and a blurry place between the two (Martens 2016). These different experiences share dramatic properties, but our community lacks a consistent vocabulary with which to speak of these experiences.

We have created a preliminary taxonomy to describe works of computationally assisted performance. It allows for scholars to be able to disambiguate the properties of this burgeoning area. Moreover, it facilitates the recognition of areas of the design space that as of yet remain unexplored, providing inspiration to create experiences that break new ground. This work in turn is inspired by taxonomies of other domains (Bartle 2004; Smith et al. 2011; Warpefelt and Verhagen 2015) and proposals for future directions of AI-based game design (Eladhari et al. 2011; Horswill 2014; Treanor et al. 2015).

Source Experiences

Our taxonomy was derived by examining a range of existing work that could be considered performative in nature. A thorough description of each is outside the scope of this paper, but a brief description of some exemplar pieces will assist the reader in understanding the description of the taxonomy, and serve to illustrate its expressive breadth. Some of the pieces below are representative exemplars of a given type of work, while others represent singular works.

Non-Computationally Assisted Performance

These are works in which technology does not play a substantial role in the experience as it is traditionally performed (we accept that some extraordinary individual productions will go against this styling).

- ***Hamlet*:** A classic play (Shakespeare 1904); prime holodeck material (Murray 1997). Other examples: Our Town, Death of a Salesman, Barefoot in the Park, etc.
- **Forum theatre:** The most famous form of Augusto Boal's Theatre of the Oppressed (Boal 2000). Trained actors perform scenes, which are then re-performed with spectators assuming roles in the piece (turning them into *spect-actors*). A *Joker* stares at the audience and disrupts scenes to prevent catharsis and fanciful solutions. Other examples: Image theatre, Rainbow of Desire.
- ***Sleep No More*:** An immersive theatre experience (White 2012); the performance space is a multi-floor building which actors traverse in a scripted performance. Audience members are free to follow the actors—or ignore them to explore the venue—as they see fit. Other examples: Then She Fell, The Good and The True, Here Lies Love.

Fully Computational Experiences

These are experiences in which technology is the primary interface or mode of interaction.

- ***Façade*:** The seminal work of interactive drama to date. While parsing player action and input, a drama manager selects narrative beats—which a content selector sequences—to bring the virtual agents Grace and Trip to life (Mateas and Stern 2005). Singular.

- ***Sleep is Death*:** A two-player collaborative storytelling game. One player, the creator, uses an interface to construct the setting, music, and peripheral characters of a digital world. The other player responds by manipulating a single, central character (Rohrer 2010). Singular.
- ***Mass Effect*:** A western computer role-playing game trilogy in which players assume control of a party of space farers to save the galaxy (Bioware 2012). Other examples: Skyrim, Dragon Age, Ultima, etc.

Computationally Assisted Performance

These experiences represent a middle ground between traditional performance and digital storytelling.

- ***Bad News*:** A world generator (Ryan et al. 2015) simulates 150 years of history of a small American town. Players explore this town, engaging in conversations with NPCs that are portrayed by a human improvisational actor. A wizard updates the simulation based on player actions (Samuel et al. 2016). Singular.
- ***Séance*:** Three players are assigned roles with backstory and enter a physical tent inhabited by a spirit medium (portrayed by a trained actor). Together, they solve physical puzzles, while an unseen wizard triggers mechanical cues that make everyday physical objects appear to be magical (TwoCan Consortium 2016). Singular.
- ***Coffee: A Misunderstanding*:** Audience members are brought on stage; their dialogue is determined by the audience, through selecting choices presented by a host (Dietrich Squinkifer (writing as Deirdra Kiai) 2014). Singular.

Other Works

Other works used in creating this taxonomy that do not fall into the aforementioned categories.

- ***Escape Rooms*:** An experience where players are locked in a physical room and must solve a series of puzzles to escape. (Heikkinen, Shumeyko, and others 2016) Taken here as a general class of experience and not an exemplar.
- ***Dungeons & Dragons*:** The classical tabletop Role-Playing Game (RPG) (D&D; Gygax and Arneson 1974), where a Dungeon Master guides the experience for a group of players who each act as a single character. Other examples: Shadowrun, Call of Cthulu, etc.
- ***Vampire: The Masquerade*:** An augmented tabletop RPG/Live-Action RPG (LARP) (V:tM; Rein-Hagen 1992). Differs from D&D due to a shared world maintained by The Mind's Eye Theater that allows players from around the world to role-play together. Singular.
- ***The Monitor Celestra*:**A Nordic LARP experience that took place on a decommissioned destroyer, that immersed players in the world of Battlestar Galactica (Montola 2014). A more immersive form of roleplaying than either D&D or V:TM. Other examples: Mad About the Boy, Terra Incognita, Fade to Grey, etc.
- ***Pretend Play*:** A form of play where participants (usually children) imagine scenarios and roles in a shared experience (Fein 1981).

Taxonomy Description

Our taxonomy is predicated on the belief that instances in the design space of (computationally assisted) performance can be demarcated by the distinct *roles* played by their performers and consumers; these roles are measured across four *dimensions*. A distinct role, then, is a role which has a unique set of values across our proposed dimensions. For our purposes, this means that in a traditional theatre piece such as *Hamlet*, the actor portraying Hamlet and the actor portraying Gravedigger #2 would both be considered to have the same role of *actor*, since they both fulfill similar functions.

In this section, we present the dimensions we have found that demarcate these roles. We then describe some roles throughout our source experiences to illustrate them and their expressive potential.

Dimensions

We have identified four dimensions that demarcate the roles found in our set of source experiences. Each role is measured by assigning a value between zero and five for each dimension. This value represents the degree to which the dimension is activated in the role, ranging from very high (5.0) to non-existent (0.0); the scale is continuous.

- **Performance:** The degree to which the role is embodied, represented, or showcased—that is, how noticeable a role is at the surface of the experience. Speaking lines, making physical gestures, or being seen by an audience all would contribute to a higher Performance score. Assisting in the execution of an experience in other critical ways—such as by hidden AI systems like Façade's content selector (Mateas and Stern 2005)—might also contribute here. Performance also represents the degree of characterization a role entails. If the role typically involves a backstory, goals and aspirations, or a personality, then they would rank higher in the Performance dimension.
- **Computational:** The degree to which the role is embodied by or informed by a machine. A very high score means the role is purely mechanized, with no human intervention. A low score means it is mostly a human. Medium scores mean that both human and machine roughly contribute in equal measure (what might be called "cybernetic", "cyber-human", or "mixed-initiative" entities).
- **Consumer:** How integral the role is in producing the experience. A high score means that the role is primarily designed to be the beneficiary of the experience; a low score means that the role has more responsibility in creating the experience for others to enjoy. This dimension asks if the role is performing the experience or playing/observing it.
- **Agency:** One's capacity to influence the state of the experience. This state takes different forms across different experiences, but could include plot, character's attitudes toward one another, or the entire structure of the piece. Here, we acknowledge more nuanced notions of agency (Wardrip-Fruin et al. 2009; Mason 2013), but use this coarser definition to support the granularity of our model.

Sample Roles

To aid the reader in understanding our process, we discuss a few roles which illustrate the process of decomposing an experience into its constituent parts. A full breakdown of the roles we ascribed to each experience, and their dimension scores, can be found in Table 3.

We attempted to be as broad and generous with what constituted a role across these experiences as possible; as such, some of these roles may not conform to the reader's intuition as to what a role typically entails. To elucidate our role creation process, let us examine the roles we determined constituted the classic table top role-playing experience, *Dungeons & Dragons* (Gygax and Arneson 1974).

We identified five distinct roles in *Dungeons & Dragons*: the *Dungeon Master* who orchestrates the experience, the *Player*s who assume characters and explore the world, *NPCs* such as townsfolk, the *Monsters* of the campaign, and *Skill Checks* (the primary system of computation used to determine the results of any action which occurs in the game). In most playthroughs of *Dungeons & Dragons*, the person who is playing the Dungeon Master is responsible for embodying the NPCs and Monsters of the world: determining what actions they wish to take, and often role-playing as them, providing their dialogue and perhaps adopting vocal and physical affectations. This brings to light an important characteristic of our role determination process: a single entity (human, AI system, etc.) can fulfill multiple roles. The dimension ratings, then, are not attached to an entity, but the functions that entity assumes to enact a particular role. The individual playing the Dungeon Master has, by virtue of that role, a high amount of agency over the experience as a whole: they can choose the frequency and ferocity of random encounters, the personalities and agendas of the NPCs of the world, and many other factors. However, when that same individual assumes the role of Monster, their agency diminishes considerably. Monsters have relatively high agency in the context of combat (they choose who and how to attack given their material affordances), but most are not expected to survive the encounter in which they are introduced, thus their influence is limited.

The dimensional qualities of the roles are experience-dependent. Take, for example, the role of Wizard present in both *Bad News* and *Séance*. In both experiences, the Wizard is unseen, and has a computer through which they can manipulate the game world. However, in *Séance*, the Wizard is intended to activate triggers at key moments in the piece determined by experience progression. The overall narrative of *Séance* is largely predetermined; thus the Wizard of *Séance* is not unlike, say, an Actor in *Hamlet*, prompted by specific cues to carry out rehearsed actions that adhere to scripted structure. The Wizard in *Bad News*, however, maintains a constant communication channel with the actor portraying the NPCs (through the role Townsfolk). Through this channel, the Wizard has the capacity to influence the Townsfolk, and in so doing radically alter the course of the experience. This is not to say that the Wizard in *Séance* has no agency—one memorable performance involved the Wizard intentionally delaying a cue in order to inspire frantic desperation—but they have less than their counterpart in *Bad News*.

Dimension	**Pearson's *r* (*n = 201*)**
Performance	0.68
Computational	0.77
Consumer	0.92
Agency	0.73

Table 1: Our inter-rater reliability, as demonstrated by dimension correlation coefficients calculated using Pearson's r. A coefficient of 1.0 would indicate perfect agreement; coefficients above 0.5 signal strong agreement.

Dimension Pair	**Pearson's *r* (*n = 67*)**
Characterization, Performance	0.87
Consumer, Agency	0.57
Computational, Consumer	-0.40
Performance, Agency	0.29
Characterization, Agency	0.22
Characterization, Consumer	0.18
Consumer, Performance	0.08
Characterization, Computational	-0.08
Computational, Performance	-0.05
Computational, Agency	-0.04

Table 2: Correlation coefficients calculated using Pearson's r. Values near 0.0 indicate orthogonal dimensions, while coefficients with absolute values near 1.0 imply that one dimension in the pair is redundant. In light of these values, we merged the Characterization and Performance dimensions.

Taxonomy Creation and Validation

Here, we describe the process we followed to create and validate these roles and dimensions. To begin, we selected a small number of familiar example experiences. We then attempted to identify the roles that each one of them had, and once equipped with a small smattering of roles, we attempted to invent an n-factor model to sufficiently distinguish them. At first, we developed a five-factor model (i.e., one with five dimensions): the four dimensions previously discussed, as well as a fifth dimension called *Characterization*, which pertained to the level of characterization of the entity (the degree to which they have backstories, goals, beliefs, etc.). We then expanded our list of experiences to make it more comprehensive, seeking examples with roles that would evoke many different aspects of the dimensions.

One author made a rubric for grading each role along the dimensions, and then three authors independently scored each role for each dimension (on a continuous scale from $0.0 - 5.0$). Once complete, we looked at the standard deviation of each role, and discovered that there was substantial disagreement regarding the dimensions Characterization and Performance. After discussing these differences, we revised the rubric definition of Performance, and returned to our individual ratings and independently revised our ratings.

After assigning our new ratings, we carried out tests for inter-rater reliability using Pearson's r (since our ratings are

continuous; Gwet 2014). Here, we found very strong agreement for each dimension (see Table 1), which we take as a form of validation—that is, the strong correlation across our independent ratings suggests that our rubric for dimension rating (articulated above) is operational.

As another from of validation, we conducted tests to assess the orthogonality of our dimensions (i.e., to check for redundancy in the taxonomy). Again, we used Pearson's r, but this time we compared the mean ratings (across all three raters) for each role across each dimension. Here, we discovered very high correlation between the Characterization and Performance dimensions (see Table 2), indicating that one of them is redundant. Although further disambiguation could likely tease part some valuable distinctions between the two (a *Dungeons & Dragons* Dungeon Master, for example, has performative qualities as a narrator, but typically has little characterization), we decided to merge the Characterization dimension into the Performance one.

Role Analysis

After settling on a final set of four dimensions, we wanted to understand commonalities between similar roles across our array of source experiences (given their ratings for those dimensions). To do this, we used an Indian Buffet Process (IBP) (Ghahramani and Griffiths 2005). The IBP is a Dirichlet Process that assumes that the observed data is generated by a latent linear mixture of Gaussian distributions, but makes no assumption about the number of distributions, except that they are at least countably infinite. After performing the IBP we are left with eight latent features, and roles are clustered according to which features they have. The clusters and a visualization of the latent feature space can be seen in Figure 1. Due to limited space, we cannot discuss the results of this analysis in depth; instead, we will enumerate the clusters to provide our labels and descriptions of them, along with the roles that compose them.

- **Creative Behind the Scenes:** Roles that are handled by humans behind the scenes. These have high agency, but middling performative aspects: *D&D NPCs*, *D&D Monsters*, *V:tM NPCs*, *V:tM Monsters*, *The Monitor Celestra Organizer*, *Forum Theatre Joker*, *Bad News Wizard*.
- **Creative Player:** Players that have a high level of agency and performative aspects: *D&D Player*, *V:tM Player*, *Bad News Player*, *Façade Player*, *The Monitor Celestra Player*, *Forum Theatre Spect-actor*, *Pretend-play participant*, *Sleep is Death Creator*, *Sleep is Death Player*.
- **Scenery, Rules, and Behind the Scenes:** Roles that are handled in a rote way, either by a human or computation. Similarly, the environment that it takes place in: *D&D Skill Checks*, *V:tM Skill Checks*, *Bad News Guide*, *Puzzle Room Guide*, *Bad News Mise en Scène*, *Façade Mise en Scène*, *Mass Effect Nameless NPC*, *Mass Effect Branching Structure*, *Mass Effect Virtual Environment*, *Hamlet Stage Manager*, *Hamlet Run Crew*, *Hamlet Scenery*, *Coffee Scenery*, *The Monitor Celestra Mise en Scène*, *Forum Theatre Scenery*, *Sleep is Death Virtual Environment*.
- **Passive Audience:** The traditional theater audience: *Hamlet Spectator*.
- **Interactive Audience:** Audience that has more agency than is traditional: *Séance Player*, *Coffee Spectator*, *Sleep No More Audience*.
- **Content Selector:** Content selector for interactive drama: *Façade Content Selector*.
- **Computational Creator:** AI agent that has some agency over the experience: *Bad News World Generator*, *Façade Drama Manager*, *Façade Interpreter*.
- **Interactive Human Accessory:** A human who is part player, part actor, but with little agency: *Coffee Actor*.
- **Actor:** Actor in a traditional sense: *Hamlet Actor*, *Bad News Mortician*, *Séance Spirit Medium*, *Sleep No More Actor*, *Forum Theatre Actor*.
- **Interactive Setting:** Setting elements with more computation and agency than traditional scenery: *Séance Mise en Scène*, *Puzzle Room Mise en Scène*, *Sleep No More Mise en Scène*, *Sleep is Death NPCs*, *Séance Guide*.
- **Computer Aided Actor:** An actor whose performance is in part determined by computation: *Bad News Townsfolk*.
- **Mild Performance NPC:** An NPC that has some performance and agency: *Mass Effect Boss*.
- **Pen and Paper DM:** Dungeon Master role for a traditional RPG: *D&D Dungeon Master*, *V:tM Storyteller*.
- **Director:** Director who guides the experience: *Hamlet Director*, *Séance Wizard*, *V:tM The Mind's Eye Society*.
- **Non Performing Player:** Standard game player: *Mass Effect Player*, *Escape Room Player*.
- **Interactive Director:** Director who has high control and turns their directing into a performance: *Coffee Host*.
- **Low Performing NPC:** NPC in a game that has very little performance: *Mass Effect Enemy*, *Mass Effect Conversable NPC*.
- **High Performing NPC:** NPC in a game that gives a memorable performance: *Mass Effect Party Member.*
- **Computational Actor:** Actor in a computational experience that has more agency and performance than most NPCs: *Façade Grace and Trip*.

Unexplored Design Space

One benefit of this taxonomy is the ability to identity unexplored areas of design space. For example, we see in Table 2 that the dimensions of Consumer and Agency are strongly positively correlated (as one goes up, so too does the other), and the dimensions of Computational and Consumer are moderately negatively correlated (as one goes up, the other goes down, and vice versa). Recognizing this, we may now consider new kinds of experiences that break these correlations, since in doing so they could be considered novel.

Consumer and Agency are likely correlated because a consumer with agency is, broadly speaking, a player, and players appear in many of our source experiences. But let us consider how new designs might subvert this by, for instance, featuring non-consumer roles with high agency. A

Source Experience	Role Name	Computational	Consumer	Performance	Agency
Dungeons & Dragons	Dungeon Master	0.83	2.33	2.17	4.33
	Player	0.0	3.67	3	3.67
	NPCs	0.67	0	3.67	3.33
	Monsters	1.33	0	2.33	1.83
	Skill Checks	2.0	0.0	0.33	1.0
Bad News	Wizard	1.33	1.0	1.17	3.33
	Guide	0.0	0.0	1.5	0.67
	Mortician	0.333	1.0	3.67	2.0
	Townsfolk	2.67	1.33	4.33	3.17
	Player	0.0	3.83	3.5	3.67
	World Generator	4.33	0.0	0.67	2.0
	Mise en Scène	0.33	0.0	0.67	0.0
Séance	Guide	0.0	0.33	2.5	1.0
	Wizard	1.33	0.83	1.0	2.0
	Spirit Medium	0.0	1.0	4.42	2.0
	Player	0.0	4.42	1.67	2.0
	Mise en Scène	2.0	0.0	3.0	0.0
Façade	Grace and Trip	4.33	0.0	4.83	1.5
	Player	0.5	4.42	2.5	4.0
	Drama Manager	4.33	0.67	1.0	3.33
	Content Selector	4.33	0.67	1.67	3.83
	Parser / Interpreter	3.67	0.67	0.67	1.0
	Virtual Environment	0.67	0.33	1.0	0.0
*Mass Effect**	Player	0.33	4.5	1.67	2.5
	Party Member	2.83	0.33	3.33	1.0
	Conversable NPC	2.5	0.33	3.0	1.0
	Enemy	2.92	0.33	2.0	1.67
	Branching Tree	1.17	0.33	1.0	1.67
	Virtual Environment	1.0	0.33	1.33	0.0
*Hamlet**	Actor	0.33	0.83	5.0	1.33
	Stage Manager	1.0	0.5	0.5	1.83
	Run Crew/Booth	0.67	0.17	0.17	0.83
	Spectator	0.0	5.0	0.0	0.75
Coffee: A Misunderstanding	Host	2.67	1.33	3.33	4.5
	Actor	1.67	2.67	4.33	1.17
	Spectator	0.17	4.09	1.08	2.33
	Mise en Scène	0.67	0.0	1.33	0.0
Escape rooms	Guide	0.0	0.0	1.67	1.0
	Player	0.0	4.75	1.33	3.68
	Mise en Scène	0.68	0.0	2.68	0.0
Vampire: The Masquerade	The Storyteller	1.0	2.33	2.5	4.17
	Player	0.0	4.0	3.33	3.67
	NPCs	1.0	0.0	3.5	2.5
	Monsters	1.67	0.0	2.33	1.83
	Skill Checks	2.67	0.0	0.33	0.67
	The Mind's Eye Society	1.67	2.0	1.17	1.83
The Monitor Celestra	Player	0.33	3.5	4.67	4.33
	Organizers	1.0	1.5	1.5	3.67
	Mise en Scène	2.33	0.33	2.33	0.0
Forum theatre*	Actor	0.0	1.33	4.33	1.5
	Spect-actor	0.0	3.33	3.5	3.83
	Joker	0.0	1.33	3.0	4.83
Sleep No More	Actor	0.33	0.5	4.92	0.75
	Spectator	0.0	4.5	0.42	2.17
	Mise en Scène	0.33	0.0	2.33	0.0
Pretend play	Participant	0.0	4.0	3.33	4.83
*Sleep is Death**	Creator	1.33	3	2.83	4.17
	Player	0.83	3.5	2.68	2.68
	NPCs	1.33	0.33	2.68	0.33

Table 3: The experiences we examined to form our taxonomy, the unique roles we identified that broadly compose each experience, and mean ratings (across all three raters) for each role across our taxonomy's four dimensions. The dimension values range from 0.0 (no activation) to 5.0 (very high activation). An * in the source experience column indicates that one or more analyzed roles were omitted for space concerns.

non-consumer is someone who constructs the experience for others, while high agency denotes being involved in shaping the experience. The closest parallels to this examined in this study are the Dungeon Master from *D&D* and the Storyteller from *Vampire: The Masquerade*, however, even these roles are typically consuming rule systems and campaign content

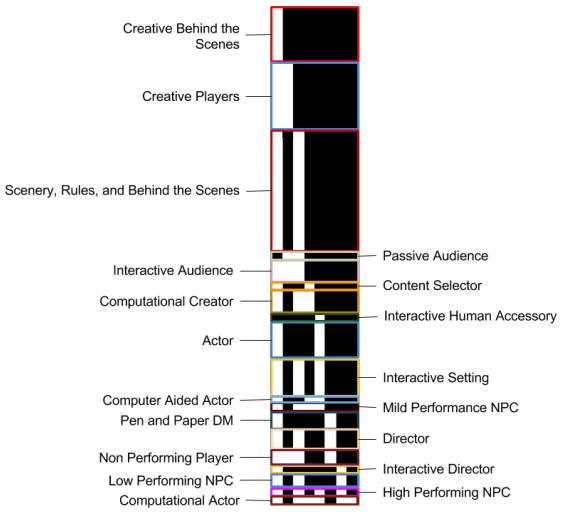

Figure 1: Role clusters determined using an Indian Buffet Process infinite mixture of Gaussians. The process determines latent features (columns) of the roles (rows) and assigns the roles to clusters (colored rectangular outlines) according to the presence of these features (black cells).

created by others, and are still considered to be playing the game. Perhaps an experience in which the designer has the capacity to globally change the rules would qualify; this would be reminiscent of a designer releasing a patch, but instead of general bug fixes and game balance repairs, the patches are narratively justified, woven into the very goals of the game itself. A suitable framing might involve players taking on the role of hackers attempting to discover sensitive data, with the patches released by the game designer making it increasingly difficult to progress. Here, the game designer is still solely producer and not consumer—they are creating an experience for the enjoyment of others—yet unlike a playwright or director, they have agency that can radically change the nature of the *ongoing* experience, and which can adapt to consumer input over time.

Computational and Consumer being negatively correlated implies that there is a lack of experiences in which a machine is the primary beneficiary of the experience. This correlation is expected, since most experiences are produced for the benefit or enjoyment of humans. However, by subverting this conventional consumption dynamic, one could imagine a class of experiences where humans perform and an AI consumes, perhaps with the aim of evaluating the human performance. One such game might be an inverse of a traditional role playing game. Instead of the player controlling a central character that largely interacts with systems controlled by AI (monsters, townsfolk, etc.), that central character (hereafter referred to as the hero) could be controlled by an AI, and every other aspect of the game controlled by the player. As the hero visits towns, the player must claim responsibility over NPC dialogue to teach the hero about the world, shape their perception of it, and incentivize their behavior through quests. When the hero enters a dungeon, the player must assume the roles of the monster the hero fights. Their goal, however, is not to defeat the hero, but rather to assist them in entering a state of flow, providing the AI with just the right amount of challenge that it is filled with a sense of *fiero*. The AI here can be evaluating the world—how consistent it is, how fair it is, how challenging it is, how complex it is—with the player constantly endeavoring to shape the arc to optimize the AI's experience. Though presumably the role the player takes on would still have some elements of consumer—as the act of crafting and shaping an experience that is judged to be one of quality can be pleasurable—the fact that roles such as the AI hero do not yet exist cues exciting new directions for AI-based game design. Such an experience shares some overlap with pet games, or even *The Sims* (Electronic Arts 2009), but to our knowledge, these experiences do not involve performance on the part of the player; nor is the happiness of the virtual agents necessarily posited as the goal of the experience. Similarly, human-based computation games—such as *ESP Game* (Von Ahn 2006), *Foldit* (Cooper et al. 2010), and *Xylem: The Code of Plants* (Logas et al. 2014)—might be considered experiences featuring AI with higher consumer values, but in these examples the AI has low agency. As such, they are the moral equivalent of the AI going to school—they might be transformed by the experience, but by and large it was a passive experience.

Conclusions and Future Work

This paper has presented a taxonomy of roles found in (computationally assisted) performance-based experiences. By identifying four dimensions that successfully distinguish these roles from one another, we have provided a language that can be used to describe the differences between the experiences themselves. Doing this enabled us to see which dimensions in current experiences are highly correlated with each other, providing inspiration to create new experiences that subvert the at-present strongly correlated dimensions. One dimension particularly strongly correlated with others is that of being a consumer. Current performance-based experiences primarily utilize AI in the service of the player; this paper outlined some thought experiments in which the AI takes on a consumer role, and the human "player" is tasked with creating a pleasurable experience for an AI.

Moreover, through the use of an Indian Buffet Process, we have identified clusters of roles that share qualities with each other across experiences. This too provides us with a vocabulary with which to describe existing experiences, as well as to recognize clusters that represent roles not commonly found in performance-based experiences, and attempt to create more experiences that have those roles. Doing so will not only more fully explore currently under-utilized areas of design space, but will provide more examples to make the taxonomy proposed in this paper more robust by bringing to light additional subtleties which must be teased apart.

It is our hope that readers will use this exploration as inspiration to continue to develop novel works of computationally assisted performance and to explore new directions in AI-based game design.

References

Bartle, R. A. 2004. *Designing virtual worlds*. New Riders.

Bioware. 2012. Mass Effect 3.

Boal, A. 2000. *Theater of the Oppressed*. Pluto Press.

Cooper, S.; Khatib, F.; Treuille, A.; Barbero, J.; Lee, J.; Beenen, M.; Leaver-Fay, A.; Baker, D.; Popović, Z.; et al. 2010. Predicting protein structures with a multiplayer online game. *Nature* 466(7307):756–760.

Dietrich Squinkifer (writing as Deirdra Kiai). 2014. Coffee: A Misunderstanding.

Eladhari, M. P.; Sullivan, A.; Smith, G.; and McCoy, J. 2011. Ai-based game design: Enabling new playable experiences. Technical report, Technical Report, UCSC-SOE-11.

Electronic Arts. 2009. The Sims 3.

Fein, G. G. 1981. Pretend play in childhood: An integrative review. *Child development* 1095–1118.

Ghahramani, Z., and Griffiths, T. L. 2005. Infinite latent feature models and the indian buffet process. In *Advances in neural information processing systems*, 475–482.

Gwet, K. L. 2014. *Handbook of inter-rater reliability: The definitive guide to measuring the extent of agreement among raters*. Advanced Analytics.

Gygax, G., and Arneson, D. 1974. *Dungeons and dragons*, volume 19. Tactical Studies Rules Lake Geneva, WI.

Heikkinen, O.; Shumeyko, J.; et al. 2016. Designing an escape room with the experience pyramid model.

Horswill, I. 2014. Game design for classical AI. In *Proc. Experimental AI in Games*.

Logas, H.; Whitehead, J.; Mateas, M.; Vallejos, R.; Scott, L.; Shapiro, D.; Murray, J.; Compton, K.; Osborn, J.; Salvatore, O.; et al. 2014. Software verification games: designing xylem, the code of plants. *Foundations of Digital Games* 1–8.

Martens, C. 2016. Towards computational support for experimental theater.

Mason, S. 2013. On games and links: Extending the vocabulary of agency and immersion in interactive narratives. In *Proc. ICIDS*.

Mateas, M., and Stern, A. 2005. Structuring Content in the Façade Interactive Drama Architecture. In *Artificial Intelligence and Interactive Digital Entertainment (AIIDE 2005)*, volume 3.

Mateas, M., and Wardrip-Fruin, N. 2016. Personalized and interactive literature. *Handbook of Science and Technology Convergence*.

Montola, M. 2014. Social reality in roleplaying games. *The Foundation Stone of Nordic Larp* 103.

Murray, J. H. 1997. *Hamlet on the holodeck: the future of narrative in cyberspace*. New York: Free Press.

Rein-Hagen, M. 1992. *Vampire: the masquerade: a storytelling game of personal horror*. White Wolf Games Studio.

Rohrer, J. 2010. Sleep is Death.

Ryan, J. O.; Summerville, A.; Mateas, M.; and Wardrip-Fruin, N. 2015. Toward Characters Who Observe, Tell, Misremember, and Lie. In *2nd Workshop on Experimental AI in Games*.

Samuel, B.; Ryan, J. O.; Summerville, A.; Mateas, M.; and Wardrip-Fruin, N. 2016. Bad News: An Experiment in Computationally Assisted Performance. In *Proceedings of the 2016 International Conference on Interactive Digital Storytelling (ICIDS 2016)*. Springer International Publishing.

Shakespeare, W. 1904. *The tragedy of Hamlet*. University Press.

Smith, A. M.; Lewis, C.; Hullett, K.; Smith, G.; and Sullivan, A. 2011. An inclusive taxonomy of player modeling. *University of California, Santa Cruz, Tech. Rep. UCSC-SOE-11-13*.

Treanor, M.; Zook, A.; Eladhari, M. P.; Togelius, J.; Smith, G.; Cook, M.; Thompson, T.; Magerko, B.; Levine, J.; and Smith, A. 2015. Ai-based game design patterns. In *Proceedings of the 10 International Conference on Foundations of Digital Games, FDG*.

TwoCan Consortium. 2016. Séance.

Von Ahn, L. 2006. Games with a purpose. *Computer* 39(6):92–94.

Wardrip-Fruin, N.; Mateas, M.; Dow, S.; and Sali, S. 2009. Agency reconsidered. In *Proc. DiGRA*.

Warpefelt, H., and Verhagen, H. 2015. Towards an updated typology of non-player character roles. In *Proceedings of the International Conference on Game and Entertainment Technologies*.

White, G. 2012. On immersive theatre. *Theatre Research International* 37(03):221–235.